

International Journal of COMPUTER AND INFORMATION SCIENCES

Volume 7, 1978

The *International Journal of Computer and Information Sciences* publishes (1) high-quality, definitive, original articles that have been appropriately reviewed by competent scientific workers, (2) reviews of recent developments in the field, and (3) tutorial and expository papers covering specific areas of interest and applications of computer and information sciences. The journal aims to provide a forum for research workers and students in the field and to expedite communication between them and other scientists interested in applications. We assume that the journal will be read by those with a common interest in computer and information sciences but with diverse backgrounds, such as engineering, mathematics, statistics, physics, chemistry, management science, library science, biomedical science, and behavioral science. Emphasis is placed upon both theoretical and experimental work that is of deep conceptual significance. The scope of the journal includes: software engineering; systems programming; pattern recognition; picture processing; computer graphics; information retrieval; computer organization; language processing; automata theory; mathematical linguistics; computer control; data structure and access; management information systems; biomedical information processing.

EDITOR-IN-CHIEF

Julius T. Tou

Director, Center for Information Research, University of Florida, Gainesville, Florida

EDITORIAL BOARD

John W. Backus

IBM Corporation, San Jose, California

Robert S. Barton

Burroughs Corporation, Paoli, Pennsylvania

Thomas E. Cheatham, Jr.

Harvard University, Cambridge, Massachusetts

T. C. Chen

IBM Corporation, San Jose, California

Harold P. Edmundson

University of Maryland, College Park, Maryland

K. S. Fu

Purdue University, Lafayette, Indiana

R. C. Gonzalez

University of Tennessee, Knoxville, Tennessee

Ulf Grenander

Brown University, Providence, Rhode Island

Alex G. Ivakhnenko

Ukrainian Academy of Sciences, Kiev, USSR

Donald E. Knuth

Stanford University, Stanford, California

David Kuck

University of Illinois, Urbana, Illinois

Leon Lukaszewicz

Academy of Sciences, Warsaw, Poland

Bruce H. McCormick

University of Illinois, Chicago, Illinois

Robert McNaughton

Rensselaer Polytechnic Institute, Troy, New York

Saburo Muroga

University of Illinois, Urbana, Illinois

Jin-ichi Nagumo

University of Tokyo, Tokyo, Japan

C. V. Ramamoorthy

University of California, Berkeley, California

J. C. Simon

Université de Paris, Paris, France

V. K. Smirnov

Academy of Sciences, Moscow, USSR

Daniel Teichroew

University of Michigan, Ann Arbor, Michigan

W. M. Turski

Warsaw University, Warsaw, Poland

W. L. van der Poel

Technische Hogeschool, Delft, The Netherlands

Michael S. Watanabe

University of Hawaii, Honolulu, Hawaii

Peter Wegner

Brown University, Providence, Rhode Island

Maurice V. Wilkes

University of Cambridge, Cambridge, England

International Journal of Computer and Information Sciences is published quarterly (March, June, September, and December) at Tempelhof 37, Bruges, Belgium, by Plenum Publishing Corporation, 227 West 17th Street, New York, N.Y. 10011. In 1978, Volume 7 (4 issues) will be published. Subscription orders should be addressed to the publisher. *International Journal of Computer and Information Sciences* is abstracted or indexed in Contents of Contemporary Mathematical Journals and New Publications, Index of Mathematical Papers, INSPEC—Computer and Control Abstracts, and Referativnyi Zhurnal. © 1978 Plenum Publishing Corporation. *International Journal of Computer and Information Sciences* participates in the program of Copyright Clearance Center, Inc. The appearance of a code line at the bottom of the first page of an article in this journal indicates the copyright owner's consent that copies of the article may be made for personal or internal use. However, this consent is given on the condition that the copier pay the stated per-copy fee through the Copyright Clearance Center, Inc. for all copying not explicitly permitted by Sections 107 or 108 of the U.S. Copyright Law. It does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotional purposes, for creating new collective works, or for resale, nor to the reprinting of figures, tables, and text excerpts.

CONTENTS

Vol. 7, No. 1

March 1978

String and Graph Grammar Characterizations of Bounded Regular Languages <i>Kenneth B. Salomon</i>	1
Time Required for Reference Count Management in Retention Block-Structured Languages, Part 1 <i>D. M. Berry, L. M. Chirica, J. B. Johnston, D. F. Martin, and A. Sorkin</i>	11
Automatic Insertion of Indexing Instructions in Program Synthesis <i>Alan W. Biermann</i>	65

Vol. 7, No. 2

June 1978

On the Time Required for Reference Count Management in Retention Block-Structured Languages. Part 2 <i>D. M. Berry, L. M. Chirica, J. B. Johnston, D. F. Martin, and A. Sorkin</i>	91
A Generating-Function Analysis of Multiprogramming Queues <i>Micha Hofri</i>	121
An Operation-Control Scheme for Authorization in Computer Systems <i>Naftaly Minsky</i>	157
Multivariate Point Process Models for Response Times in Multi-programmed Systems <i>David W. Hunter and Gerald S. Shedler</i>	193

Vol. 7, No. 3

September 1978

Analysis of Some Abstract Measures of Protection in Computer Systems <i>Clarence A. Ellis</i>	219
--	-----

CHITRA: Cognitive Handprinted Input-Trained Recursively Analyzing System for Recognition of Alphanumeric Characters	253
<i>Belur V. Dasarathy and K. P. Bharath Kumar</i>	
A Probabilistic Approach for Testing Large-Scale Integrated Circuits	283
<i>Shanker Singh and Vijendra Pal Singh</i>	
Simplified Odd-Even Sort Using Multiple Shift-Register Loops	295
<i>T. C. Chen, K. P. Eswaran, V. Y. Lum, and C. Tung</i>	

Vol. 7, No. 4

December 1978

Depth- m Search in Branch-and-Bound Algorithms	315
<i>Toshihide Ibaraki</i>	
Parsers for Indexed Grammars	345
<i>Robert W. Sebesta and Neil D. Jones</i>	
Time Required for Garbage Collection in Retention Block-Structured Languages	361
<i>D. M. Berry and A. Sorkin</i>	